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(54) Method and circuit for driving picture display devices

(57) A display device with a dot matrix of pixels which allows displaying pictures with any desired number of pixels in cases where picture signals of any given resolution are being displayed using such a display device. Each time one horizontal cycle of picture data is being loaded into the display device, identical picture signals are displayed in one or more lines, and pictures based on the picture signals are displayed at various vertical magnification factors by periodically varying the number of lines with identical signals, while varying the horizontal magnification factor in synchronization with the vertical magnification factor.

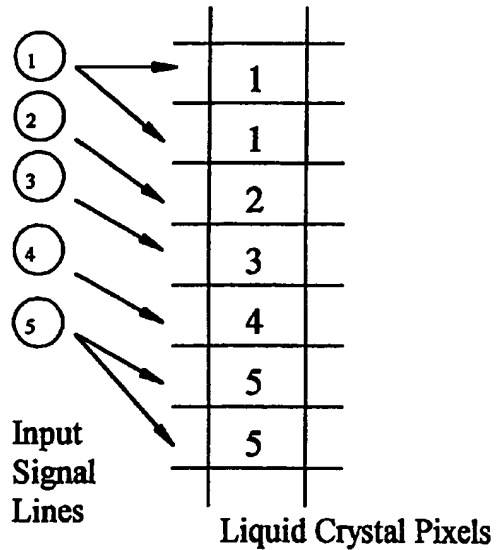


Fig. 2

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## Description

The present invention relates to a method for driving a driving circuit such as a driver or the like used in a display device with a dot matrix of pixels.

### Description of the Prior Art

According to prior art, writing pictures to liquid crystal pixels is performed with, for example, a liquid crystal display device, by providing liquid crystal display elements with TFT devices used as switching devices for application of voltages to liquid crystal pixels with a configuration where one TFT device is used as one pixel, drain terminals of the TFT devices are connected to electrodes for the liquid crystal pixels and their gate terminals and source terminals are arranged as lengthwise and lateral common terminals, applying voltages for the respective pixels to their source common terminals as picture signals and applying voltages for continuity between sources and drains of the TFT devices to their gate common terminals thereby applying ON-voltages to all the TFT devices connected to the gate common terminals (usually for one horizontal line on the display screen) to establish continuity between the sources and the drains.

FIG. 7 is a view of the configuration of a conventional liquid crystal panel with TFT devices. Liquid crystal display devices are driven by two types of driving elements designated as source driver and gate driver, connected to the TFT devices. In the case of liquid crystal panels with pixels 1280 dots wide by 1024 dots high as shown there, for displaying of input signals of 1280 x 1024 resolution, for example, picture data for each pixel is designed to be displayed with a single dot of the liquid crystal panel, eventually filling the 1280 x 1024 screen exactly.

On the other hand, in cases where the input signals have a 640 x 400 resolution, each pixel of picture data is magnified twice vertically and horizontally as shown in FIG. 5 for displaying over four dots of the liquid crystal panel, thus resulting in an enlarged display using 1280 x 800 pixels of the liquid crystal panel as the display screen. As described above, the resolution of input signals is increased twice vertically and horizontally for enlarged displaying so long as the increased resolution does not exceed the number of pixels of the liquid crystal panel. This also applies to other input signals of resolution capable of being increased by an integral multiple, and displaying is performed with no more than the maximum integral multiple of the resolution which does not exceed the number of pixels of the liquid crystal panel used in either of the vertical and the horizontal directions.

Picture display areas have a variety of resolutions depending on the particular pieces of hardware and software used. For example, in cases where input signals have a 1024 x 768 resolution and this resolution is magnified twice vertically and horizontally to 2048 x

1536 which exceeds the number of pixels of the liquid crystal panel used, all the information of the input signals cannot be displayed on such a liquid crystal panel as shown in FIG. 7. Therefore, displaying is performed with the original 1024 x 768 resolution, as shown in FIG. 6. This naturally results in a display at the center or another area of the liquid crystal panel at a smaller size than the liquid crystal panel. In this case, however, since the full liquid crystal panel screen is not used, there is presented a problem of, for example, a dark screen because of insufficient use of light from the light source since an increased area is shielded from light in cases where the liquid crystal panel is used as a light crystal projector.

It is therefore an object of the invention to provide a method and circuit for driving a picture display device of a dot matrix type, which is capable of displaying pictures with a better use of pixels of the picture display device, regardless of the resolution of the picture display device.

According to the present invention, there is provided a method for driving a picture display device with a dot matrix of pixels to display pictures based on picture signals of any given resolution with any desired number of pixels using the display device, comprising: displaying an identical picture signal of one horizontal scanning period in one or more lines each and varying the vertical displaying magnification factor for the picture signal by periodically varying the number of lines which display the identical signal.

### BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of the present invention will become more apparent when the following description is read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a view illustrative of the configuration of an embodiment according to the present invention;

FIG. 2 is a view illustrative of the embodiment according to the present invention;

FIG. 3 is a view illustrative of an instance of displaying according to the embodiment of the present invention;

FIG. 4 is a view illustrative of a drive timing chart for a liquid crystal driver IC which realizes the embodiment according to the present invention;

FIG. 5 is an instance of writing to liquid crystals according to the prior art;

FIG. 6 is an instance of displaying of a picture according to the prior art;

FIG. 7 is a view illustrative of the configuration of a conventional liquid crystal panel;

FIG. 8 is a view illustrative of the configuration of the representative gate driver;

FIG. 9 is a view illustrative of an embodiment of a timing control circuit according to the present invention; and

FIG. 10 is an operation timing chart for the timing control circuit shown in FIG. 9.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

First, an embodiment of the present invention will be explained with reference to a case where a TFT active matrix liquid crystal display is used as a picture display device with a dot matrix of pixels.

FIG. 1 is a view illustrative of the configuration of an embodiment according to the present invention, FIG. 2 is a view illustrative of the operation of the embodiment of the present invention, and FIG. 3 is a view illustrative of an instance of displaying a picture with the embodiment according to the present invention. In addition, FIG. 4 is a view illustrative of an instance of the drive timing chart of a liquid crystal driver IC which realizes the embodiment according to the present invention.

In FIG. 1, 1 denotes a picture signals are input terminal through which picture signals are inputted to a data driver 4. In addition, 2 denotes a synchronizing signal input terminal through which, for example, horizontal synchronizing signals and vertical synchronizing signals are inputted. 3 denotes a timing control circuit or a circuit for supplying a variety of timing pulses or clocks, etc. to the data driver 4 and a gate driver 5 in order to display input picture signals on a liquid crystal panel. Also, 7 denotes a PIL circuit and 8 is the liquid crystal panel.

The present invention relates to a liquid crystal panel driving circuit which is effective for displaying input signals of lower resolution than the number of pixels of the liquid crystal panel used for displaying images; for example, it is a liquid crystal panel driving circuit which makes a better use of pixels of a liquid crystal panel display in cases where input signals of 1020 x 768 resolution are being displayed on a liquid crystal panel with resolution 1280 pixels wide by 1024 pixels high. The state of a picture displayed according to the present invention is such one as illustrated in FIG. 3.

A characteristic aspect of the present invention resides in a method for loading picture data into liquid crystal pixels, as shown in FIG. 2, which is a characteristic method for driving the gate driver 5 mainly vertically. First, the case will be described where pictures of input signals of 1024 x 768 resolution are being displayed through a better use of the screen of a liquid crystal panel with resolution 1280 pixels wide by 768 pixels high. Assuming that the pictures are magnified at an identical ratio vertically and horizontally, the resolution becomes 1280 x 960 when the ratio is 1.25 times in both the vertical and the horizontal directions, and this 1.25-times magnification allows better use of the pixels of the used liquid crystal panel for enlarged display of pictures of input signals. The process of the 1.25-times vertical magnification is actually accomplished by loading every four lines of picture data into five lines of the liquid crystal panel. More specifically, one of the four

lines of picture data is loaded into two lines of the liquid crystal panel, and the remaining three lines of picture data is loaded into three lines of the liquid crystal panel, respectively. A chart illustrative of drive timing by a gate driver IC at this point in time is as shown in FIG. 4. Here, the data driver for guiding picture signals to the liquid crystal pixels are designed to sample and hold each line of the picture signals for outputting to the liquid crystal pixels. The configuration of a representative gate driver is illustrated in FIG. 8.

As a brief explanation with reference to FIG. 4, when the picture data is for scanning line 1, timing is provided to output gate pulses of the first line and the second line of the gate driver IC. Subsequently, when the picture data is for scanning lines 2 through 4, pulses of the third lines through fifth line of the gate driver IC are generated in succession. With these timing pulses, loading of each four lines of picture data into five lines of the liquid crystal panel is repeated until a total of 768 vertical lines of picture data is loaded into 960 lines of the liquid crystal panel to accomplish a 1.25-times vertical magnification. On the other hand, in the horizontal direction, for example, in cases where the picture signals are digitized, the sampling clocks are increased to 1.25 times in synchronization with the vertical magnification/reduction factor, and the number of samples of the picture data is increased from 1024 dots to 1280 dots or 1.25 times for the horizontal magnification.

In this connection, FIG. 9 illustrates an instance of the configuration of the timing control circuit 3 for generation of the gate driver IC shift clocks shown in the timing chart of FIG. 4, while FIG. 10 illustrates timing charts for the respective signals. For a brief explanation with reference to FIG. 9, first, input clocks 22 and half clocks 23 generated by dividing the clocks 22 into halves by a divider 15 are inputted to A and B of a selector 17, respectively. The function of this selector 17 is designed to output the A input to Y when the selector terminal S is at a low level and the B input to Y when the selector terminal S is at a high level. The counter 16 is designed so as to count up upon reverse clocks of the input clocks 22 and to input an output 24 of the counter 16 to A of each of two comparators 18 and 19.

On the other hand, appropriate data depending on the magnification factor at that time is inputted to B of each of the comparator 18 and the comparator 19; in this embodiment it is intended that "2" is inputted to B of the comparator 18, while "7" is inputted to B of the comparator 19. In other words, the output 25 of the comparator 18 is LOW when the output 24 of the counter 16 is smaller than 2 and HIGH when the output 24 of the counter 16 is 2 or greater, whereas the output 26 of the comparator 19 is HIGH when the output 24 of the counter 16 is 7 and LOW otherwise. The output 25 of the comparator 18 is connected to the selector terminal S of the selector 17, while the output 26 of the comparator 19 is connected to the reset terminal of the counter 16. Here, the counter 16 is designed to be such a counter as to be reset in synchronization with a clock when the

reset terminal is HIGH. The operation of the above-explained timing control circuit shown in FIG. 9 is illustrated by the timing chart shown in FIG. 10 which demonstrates the successful operation of the present invention by realizing such a gate driver IC drive timing chart as shown in FIG. 4.

Even drivers which have different configurations and different modes of operation from the gate driver and the data driver described above may accomplish the desired function so long as each single line of picture data may be loaded into a plurality of lines of the panel and the number of lines for loading is controllable within one frame. It will be easily understood that the effect of the present invention may be produced not only by timing operation with a driver IC as shown in FIG. 4 which is means for loading each one line of picture data into a plurality of lines of the panel without using any storage element such as a memory, but also by using a storage element such as a memory.

In the same manner as the one described above, the magnification of display may be varied as desired for other magnification factors as well by controlling the number of writable lines (controlling the drive timing with the gate driver IC) with respect to the vertical direction and by varying the sampling clocks with respect to the horizontal direction.

In addition, the present invention may be applied to display devices with a dot matrix of pixels, and an entirely identical effect to that of the present invention may be produced in any mode of displaying in which picture data is distributed to the respective pixels for displaying so long as the distribution of picture signals to the respective pixels for displaying may be achieved in the same manner as in the embodiment described above. In other words, the present invention may also be applied to display devices other than the TFT active matrix liquid crystal display explained in the above embodiment, for example, display devices with a dot matrix of light-emitting elements such as LEDs or plasma displays.

As explained above, with picture display devices with a dot matrix of pixels, the present invention allows better use of displayable areas of such picture display devices by writing and displaying of the maximum picture data possible over the entire displayable areas of the picture display devices, which is achieved by a technique for displaying each picture over an any desired number of pixels in cases where picture signals of any given resolution are being displayed on the picture display devices used.

#### Claims

1. A method for driving a picture display device with a dot matrix of pixels to display pictures based on picture signals of any given resolution with any desired number of pixels using the display device, comprising:
  - displaying an input picture signal in one or

more lines each and varying the vertical displaying magnification factor for the picture signal by varying the number of lines which display the identical signal.

2. A method for driving a picture display device as claimed in claim 1, wherein the horizontal magnification factor of the pictures is varied in synchronization with the vertical magnification factor.
3. A driving circuit for driving a picture display panel with a dot matrix of pixels, comprising:
  - a data driver for receiving picture signals and horizontally driving the display panel;
  - a gate driver for vertically driving the display panel; and
  - a timing control circuit for providing said gate driver with timing so as to display an identical picture signal in a plurality of lines synchronized in advance upon receipt of a synchronizing signal.

Fig. 1

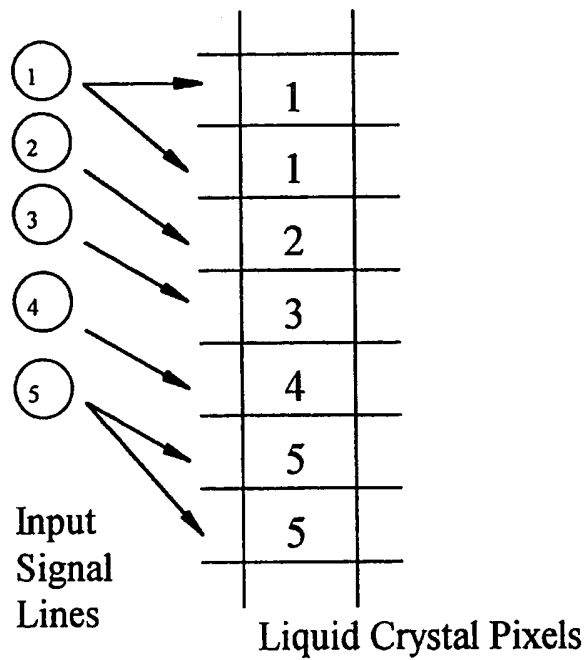
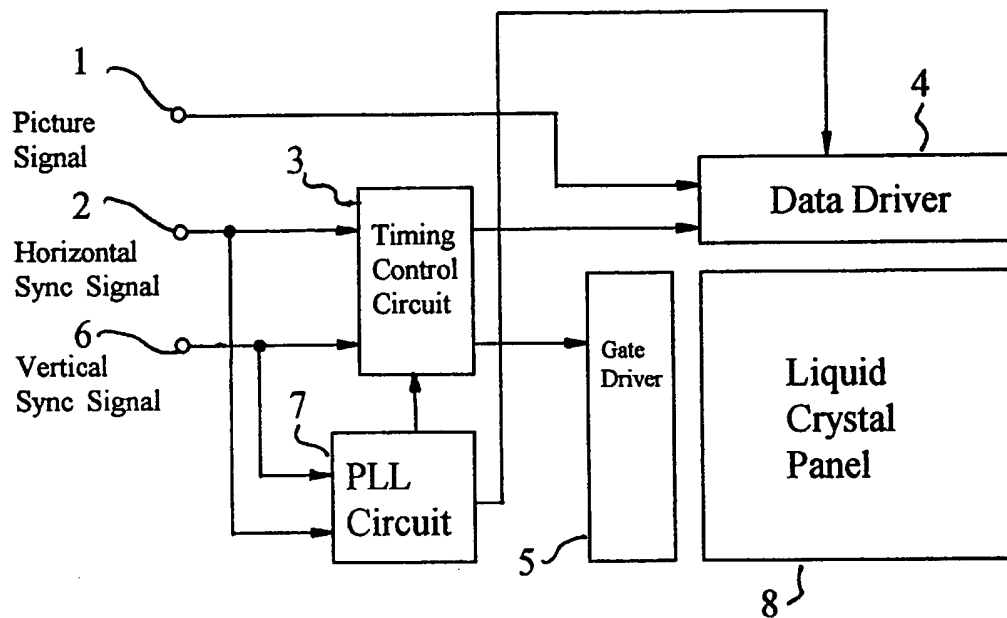


Fig. 2

Fig. 3

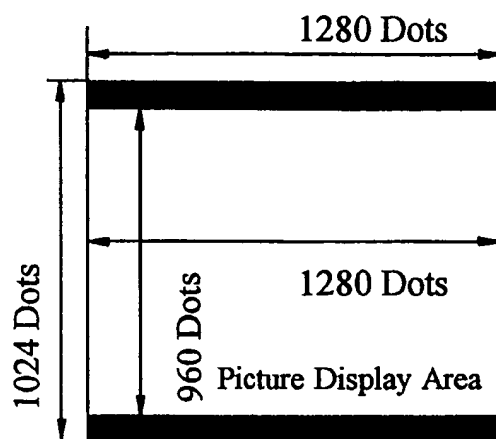


Fig. 4

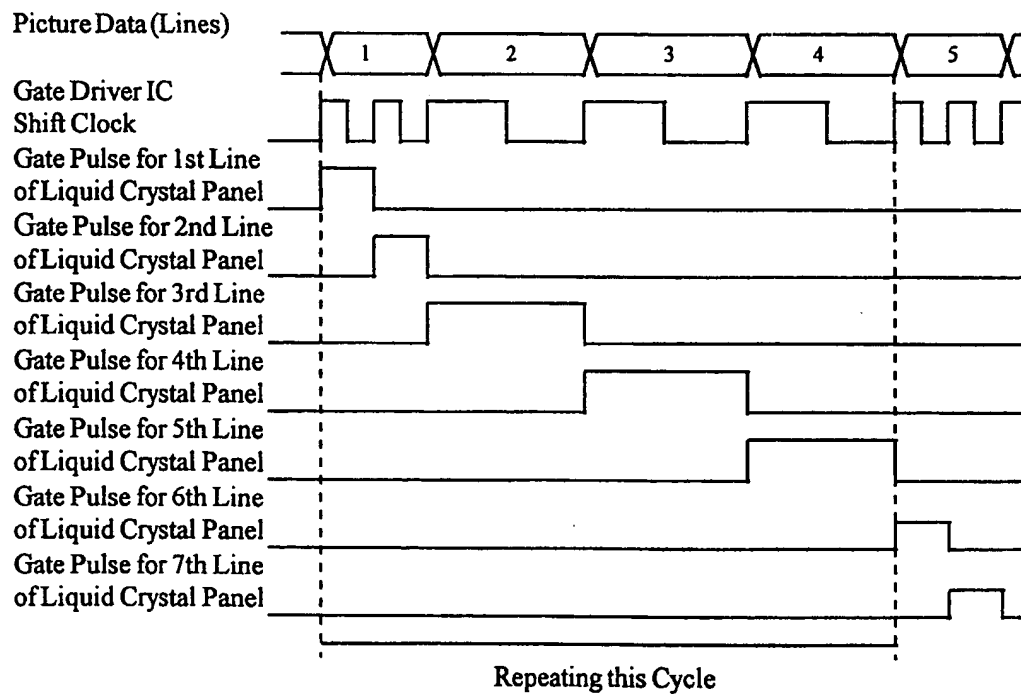


Fig. 5

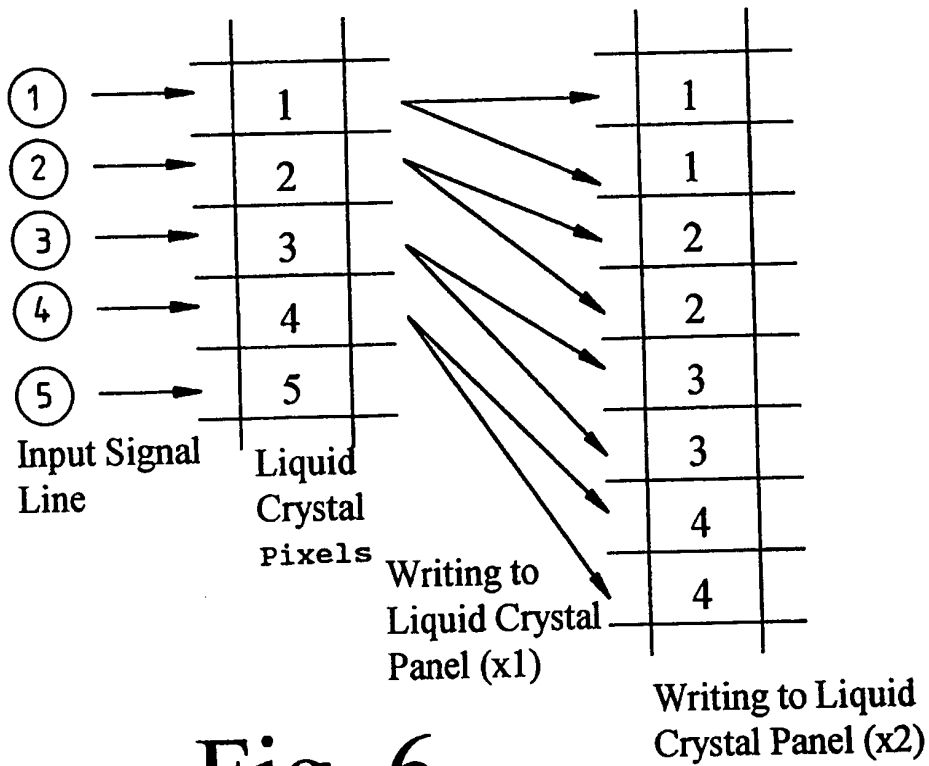


Fig. 6

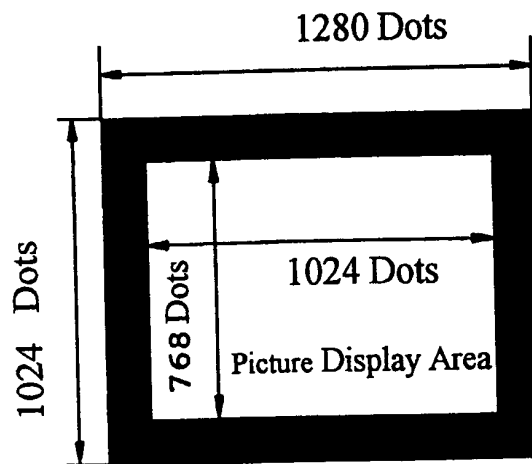




Fig. 7

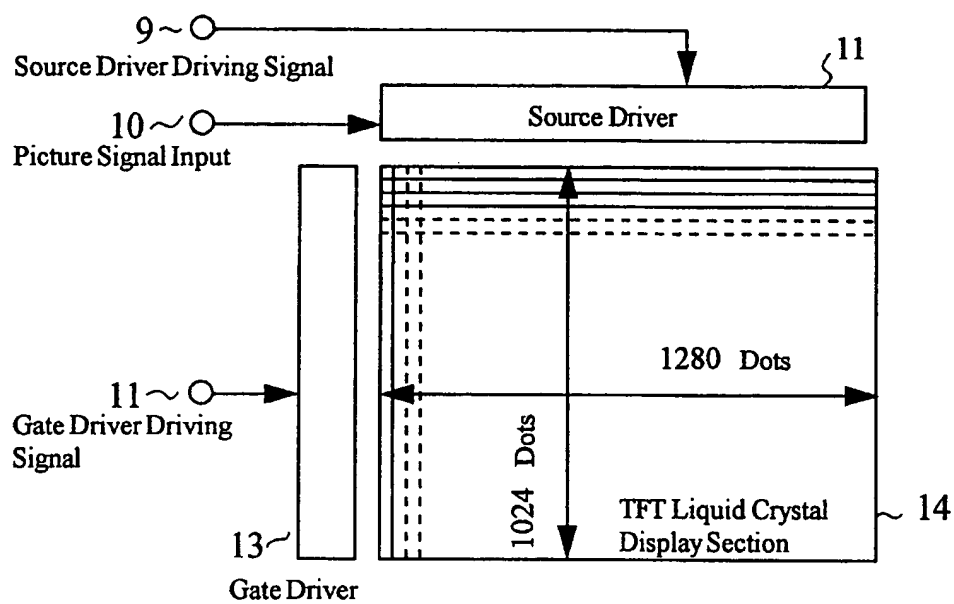


Fig. 8

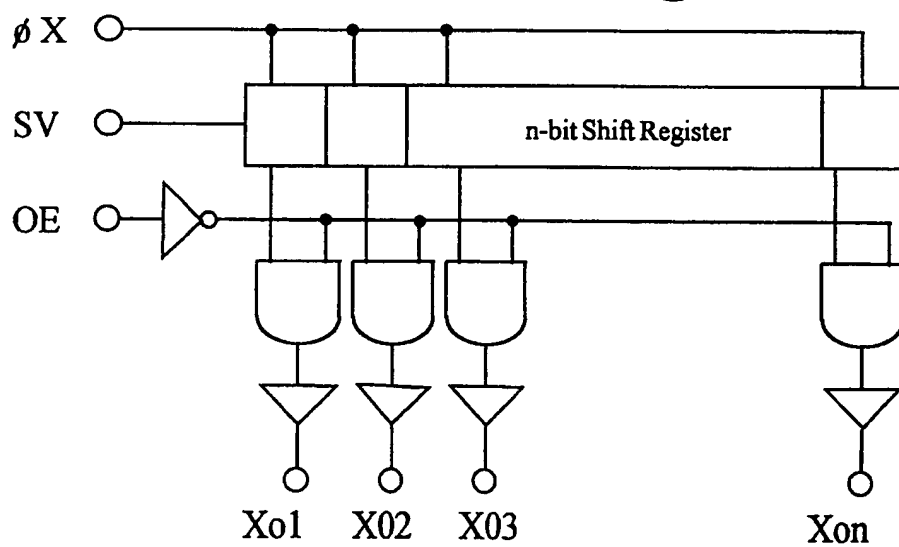


Fig. 9

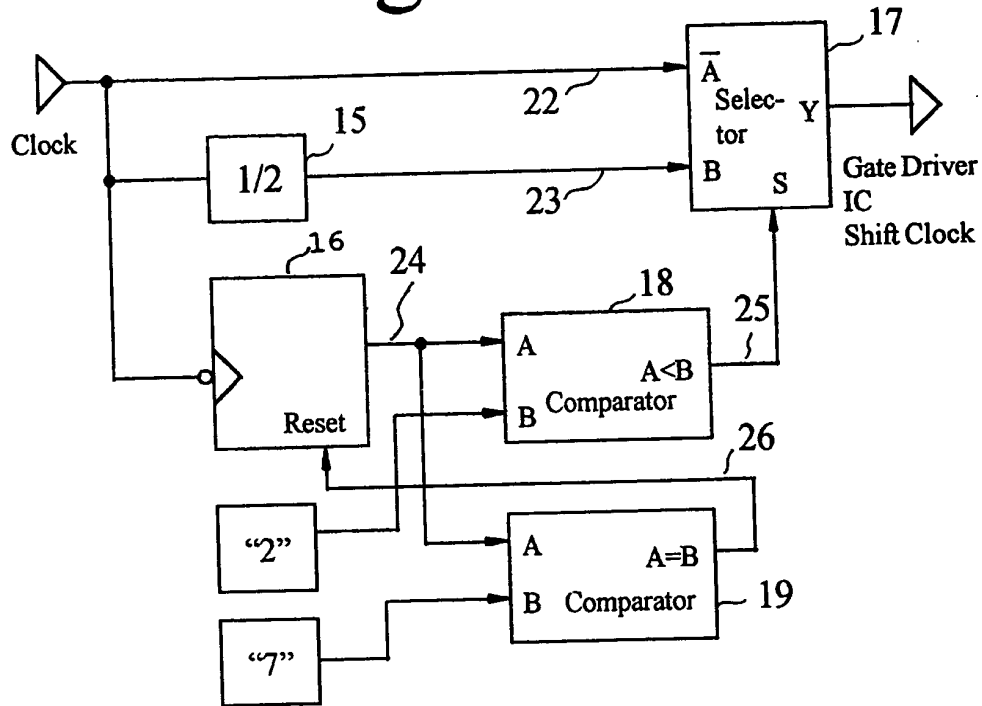
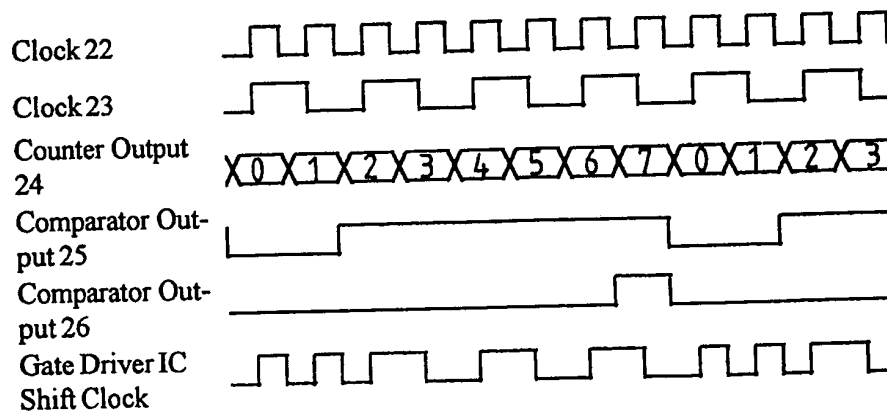


Fig. 10





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# EUROPEAN SEARCH REPORT

Application Number  
EP 95 11 9322

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP-A-0 540 294 (CANON KABUSHIKI KAISHA) 5 May 1993 * abstract * * page 6, line 4 - page 6, line 20 * * page 11, line 23 - page 11, line 48 * * claim 12 *	1-3	G09G3/20 G09G3/36
X	DE-A-44 12 429 (MITSUBISHI DENKI K.K.) 27 October 1994 * page 1, line 3 - page 1, line 11; figures 5,6,11,12,21 * * page 4, line 5 - page 4, line 16 *	1,3	
X	DE-A-38 40 839 (MITSUBISHI DENKI K.K.) 29 June 1989 * abstract; figure 6 *	1,3	
A	EP-A-0 574 142 (INTERNATIONAL BUSINESS MACHINES CORPORATION) 15 December 1993 * figures 22,46 *	2	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			G09G
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 11 April 1996	Examiner Van Roost, L
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons</p> <p>&amp; : member of the same patent family, corresponding document</p>			

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